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Ocean Engineering

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC   20374

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UNDERWATER INSPECTION
AND RECOMMENDATIONS FOR THE
BRIGHTON DAM ACOUSTIC FACILITY
Naval Surface Weapons Center
Brighton, Maryland

FPO-1-84 (40)
March 1985

by

William N. Seelig, P.E.
and
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CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC 20374

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19. ABSTRACT (Continue on reverse if necessary & identify by block number)
The Chesapeake Division, Naval Facilities Engineering Command (CHESDIV) Ocean Engineering and Construction Project Office conducted an underwater inspection of the Brighton Dam Acoustic Facility barge on 1 November 1984. The inspection was made by U.S. Navy and Army diving officers and civilian (Con't

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engineers. Analysis of NSWC barge freeboard measurements and the inspection data show: (1) a safe barge freeboard has been maintained for the past seven years with little change in freeboard observed. (2) the 44 "P" pontoons supporting the instrument house are in good structural condition with some pitting and beaching of the metal near the waterline and (3) pitting and breaching are not critical because the pontoons are foam filled. Wood beams between the pontoons are instrument house are in good condition.

Based on the results of the underwater inspection and analysis of additional data we conclude: (a) The facility is in good condition and should continue to give service at current rates of maintenance funding. (b) Pontoon replacement is not needed and not recommended. (c) Replacement of the barge is not recommended. (d) The receiving float could be replaced at a cost of approximately $20 K to reduce the draft of the pontoons by 2 feet. This would reduce the impact of low lake levels. (e) The crane rails on the barge and shore cannot be upgraded to 3,000 pounds capacity without significant modifications. (f) Monthly barge freeboard measurements should be taken and a swim-by inspection of the underwater portions made every three years.

UNDERWATER INSPECTION AND RECOMMENATIONS FOR
THE BRIGHTON DAM ACOUSTIC FACILITY
Naval Surface Weapons Center   (NSWC)

by

William N. Seelig, P.E.
James Hansen

EXECUTIVE SUMMARY

The Chesapeake Division, Naval Facilities Engineering Command
(CHESDIV) Ocean Engineering and Construction Project Office
conducted an underwater inspection of the Brighton Dam Acoustic
Facility barge on 1 November 1984. The inspection was made by U.S.
Navy and Army diving officers and civilian engineers. Analysis of
NSWC barge freeboard measurements and the inspection data show: (1)
a safe barge freeboard has been maintained for the past seven years
with little change in freeboard observed; (2) the 44 "P" pontoons
supporting the instrument house are in good structural condition
with some pitting and breaching of the metal near the waterline and
(3) pitting and breaching are not critical because the pontoons are
foam filled. Wood beams between the pontoons and instrument house
are in good condition.

Based on the results of the underwater inspection and analysis
of additional data we conclude:

(a) The facility is in good condition and should continue to give
service at current rates of maintenance funding.

(b) Pontoon replacement is not needed and not recommended.

(c) Replacement of the barge is not recommended.

(d) The receiving float could be replaced at a cost of approximately
$20 K to reduce the draft of the pontoons by 2 feet. This would
reduce the impact of low lake levels.

(e) The crane rails on the barge and shore cannot be upgraded to
3,000 pounds capacity without significant modifications.

(f) Monthly barge freeboard measurements should be taken and a
swim-by inspection of the underwater portions made every three years.

CONTENTS

UNDERWATER INSPECTION AND RECOMMENDATIONS FOR
THE BRIGHTON DAM ACOUSTIC FACILITY

Naval Surface Weapons Center

by

William N. Seelig, P.E.

BACKGROUND AND FACILITY DESCRIPTION

The Naval Surface Weapons Center (NSWC), White Oak, MD has a
floating acoustic facility located at Brighton Dam, MD (Figure 1).
The facility consists of a barge supported by 44 "P" pontoons and a
floating walkway connecting the barge to shore (Figures 1 and 2).
The facility is over thirty years old (Table 1) and only one other
underwater inspection was made in February 1981 (Reference (1)). A
number of widely varying recommendations have been made as to what
to do with the facility (Table 2).

STUDY PURPOSES

The purposes of this report are to:

(1) Report results of an analysis of barge freeboard measurements
made by NSWC.

(2) Report on the results of the underwater inspection of the
barge.

(3) Make recommendations based on inspections and analyses.

Table 1

Project History Summary

Hydroacoustic Measurements Facility, Brighton Dam

Naval Surface Weapons Center

1940's	Facility built and installed
1952	Barge moved to Brighton Dam
1953	Barge installed and put into operation
1968-69	Foam added to pontoons
9-11 Feb 81	Underwater inspection of hull made
20 Apr 81*	Report "Hull Survey-"Brighton Dam..." by EPOCH with recommendations (Ref 1)
10 Feb 82*	Report "Brighton Dam Acoustic Facility Study" by NSWC with recommendations (Ref 2)
17 May 82*	MEMO "A New Proposal ..." NSWC memo with more recommendations" (Ref 3)
7 Nov 83	Public Works letter to NCEL asking for recommendations
21 Dec 83*	NCEL letter to NSWC with recommendations (Ref 4)
23 Apr 84	CHESDIV (Hansen) visits site
27 Apr 84	NSWC ESR-WOL-392 to CHESDIV
22 Jun 84	CHESDIV letter to NSWC with scope of work and requesting funds
5 Oct 84	CHESDIV (Seelig) visits site
10 Oct 84	CHESDIV received funding from NSWC
1 Nov 84	CHESDIV performs underwater inspection of barge

* Contains recommendations

Table 2

Brighton Dam Acoustic Facility
Studies and Recommendations to Date

Date	Reference	
Feb 81	(1)	Epoch Engineering made an underwater inspection February 1981 and concluded:
		a. "approximately 1/3 of the flotation pontoons require immediate attention
		b. "the flotation system should be, as a minimum, updated to current state-of-the-art with respect to weathering, corrosion and quietness".
Feb 82	(2)	In-house NSWC study recommended:
		a. Replace instruments ($143,000) or
		b. Replace/repair facility for long term continued operation ($436,700). or close the facility ($64,800).
May 82	(3)	In-house MEMO with new recommendations:
		a. continue testing
		b. monitor barge freeboard
		c. keep expenditures for improvement to a minimum.
Dec 83	(4)	NCEL reviewed Epoch Engineering report (Reference 1) and stated:
		a. "Water is absorbed by the foam very slowly, so deterioration of the steel shell can occur without serious danger.
		b. "The third alternative, to fabricate a complete new barge, is recommended".

3

THE BARGE FREEBOARD

One of the most important questions to ask about a floating
vessel is "Is it sinking?". NSWC wisely has been measuring the barge
freeboard of the Brighton Dam facility from 1978 to the present.
These measurements show that the barge is not sinking and that the
average freeboard has not varied more than 1/2 inch from the mean
value of 28.7 inches for the past seven years (Figure 3).
In fact, the freeboard increased during the latter portion of
1984 (Figure 3). The increase in freeboard is a direct result
of removing heavy electronic gear from the barge and
installing lightweight equipment in early 1984 (W. Phelps, personal
communication, 5 November 1984).

These measurements also show that the barge is slightly listing
with greater freeboard to the west and north corners (see Figure 3,
upper right). The freeboard of the west corner of the barge is
2.7 inches above the average barge freeboard and the east corner is
3.3 inches below average. Listing of the barge is due to the
combined effects of: (1) the weight distribution and (2) pontoons on
the east corner of the barge were not completely filled with foam
(W. Phelps, personal communication, 5 November 1984).
This slight listing is not important.

Calculations show that the barge has on the order of 80,000
pounds of reserve buoyancy and the water temperature will only have
a very minor influence on freeboard (Appendix A).

UNDERWATER INSPECTION PROCEDURE

The underwater inspection included three levels of effort:

LEVEL I: Examine undisturbed sections of the pontoons, collect
            samples of corrosion products and a grab sample of the
            foam. Photograph undisturbed sections. Examine the condition
            of wood.

LEVEL II: Clean 8"x 8" areas of the pontoons on all exposed pontoon
            faces underwater. Cleaning was done on the center of the
            bottom of each pontoon and just below the water line in the
            center on each accessible pontoon side. Visual observations
            were made and photos taken.

LEVEL III: Make metal thickness measurements.

A list of personnel participating in the inspection is given in
Table 2.

Figure 4 indicates the code used to identify individual pontoons.

Table 3. Key Personnel

<u>Divers</u>

CDR H. S. Stevenson, CEC, USN	CHESNAVFACENGCOM(FPO-1)
Mr. Herb Herrmann	NAVFACENGCOM(FAC-07)
LCDR A. E. Bertsche, CEC, USN	CHESNAVFACENGCOM(FPO-1)
LCDR J. M. Cherry, CEC, USN	NAVELEXSYSCOM(PDE-124)
LCDR G. S. Guthrie, Jr., CEC, USN	NAVSEASYSCOM(PMS-395)
LCDR R. B. Steimer, CEC, USN	NAVFACENGCOM(FAC-07)
LT M. B. Samuels, CEC, USN (Diving Officer)	CHESNAVFACENGCOM(FPO-1)
1LT D. A. Sykes, CEC, USA	86th Engineering Detachment (Diving)
Mr. Allan Hubler, Ocean Engineer	CHESNAVFACENGCOM(FPO-1)

<u>Record Keeping</u>

Mr. Bill Seelig, Civil Engineer	CHESNAVFACENGCOM(FPO-1)

<u>Observers</u>

Mr. Glenn Reid, Facility Manager	NSWC (Code U42E)
Dr. Shun Ling, Director, Engineering Analyses Division	CHESNAVFACENGCOM(FPO-1)

<u>Assistance</u>

Mr. G. B. Phelps, Engineering Technican	NSWC (Code U42E)
Mr. Tom Kelly, Engineering Technican	NSWC (Code U42E)

RESULTS

Cleaning and visual inspections show that:

1. Conditions are similar to those reported as a result of the February 1981 inspection (Reference (1)). In fact, areas cleaned in 1981 could easily be seen indicating little change.

2. Most regions are in good shape and the original paint can be seen in some areas. The bottoms of the pontoons are in especially good shape. All areas can be classified as "structurally sound" meaning that they can support load and retain structural integrity.

3. Corrosion occurs from the waterline to one-foot below the waterline on the faces of the pontoons (see Figure 5). A number of holes are present in pontoons A-5, C-5 and K-3. The combined action of small waves and/or ice motion is probably responsible for the corrosion and damage near the waterline.

4. Pitting type corrosion controls elsewhere (Figure 6). The amount of pitting varies from one pontoon to the next and from one spot on a pontoon to another. These "hot spots" of corrosion may be in part due to imperfections in the metal and break down in the coating system.

Selected photographs are given in Appendix B.

Analysis of the underwater inspection data and subsequent analyses reveal that:

1. Most of the original metal remains and that selective pitting and corrosion in isolated spots controls.

2. A grab sample of the foam from pontoon A-5 shows the foam to be in good condition with only the outer few millimeters damaged. As Reference (4) states "Water is absorbed by the foam very slowly...". Analysis of the barge freeboard shows that the barge has 80,000 pounds of reserve buoyancy (Appendix A).

3. The receiving float could be redesigned with a number of small floats (Appendix C). The proposed receiving float would have a draft at least 2 feet less than the present float, therefore, low lake levels would have less of an impact on facility operations. However, the two foot decrease in draft would cost approximately $20 K.

4. Analysis of the monorail crane steel beams on shore and on the barge (Appendix D) shows that the capacity rating of the cranes cannot be increased above 2,000 pounds without significant structural modification. The rail crane on shore is especially weak (has a low section modulus) in light of the design manual (NAVFAC DM 38.1, "Weight Handling Equipment", June 1982).

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The underwater portions of the 44 foam-filled "P" pontoons supporting this facility are in good condition. This surprisingly good condition occurs because the facility has been well maintained and is in sheltered fresh water.

Pitting controls corrosion and there is some penetration on exposed faces of the barge just below the water level. Overall the underwater steel has good structural strength and pits/penetrations are largely irrelevant because pontoons are foam filled. Seven years of barge freeboard measurements by NSWC show the barge has significant reserve buoyancy. A grab sample of the foam from pontoon A-5 showed that then foam is in good condition.

The facility is well maintained, is in good condition and no major increase in maintenance funding should be needed in the near future.

Replacement of the pontoons or the barge is not necessary, based on the condition of the facility.

NSWC can replace the pontoon receiving float for approximately $20 K to reduce the impact of low lake levels on the transfer of equipment and personnel (Appendix C).

The rated capacity of the monorail cranes on the barge and shore cannot be increased without major structural modification (Appendix D). For example, analysis of the support beams using the present code shows that the beams should not be rated for 3000 pounds. The shore rail is especially weak when compared to the latest code.

As an absolute minimum NSWC should make: (1) monthly barge freeboard measurements and (2) a swim-by underwater inspection every three years.

9

References

1. "Hull Survey-Brighton Dam Instrumentation Barge" Epoch
    Engineering, Inc., 20 April 1981, study performed for NSWC.

2. "Brighton Dam Acoustic Facility Study", NSWC, 10 February 1982.

3. "A New Proposal Concerning the Operation of the Brighton Dam
    Acoustic Facility", NSWC Memo of 17 May 1982 from Code U45 to
    U40.

4. NCEL letter of 21 December 1983 to NSWC, subj: Technical
    Survey of Floating Laboratory Hull at Brighton Dam Facility.

5. Pontoon System Manual, NAVFAC P-401, October 1982.

6. Handbook of Ocean and Underwater Engineering, J. Myers, Editor,
    McGraw-Hill Book Company, 1969.

7. Bureau of Yards and Docks Drawings dated 4 June 1952:

Sheet No.	Number	Title of Sheet
1	528203	Site and Mooring Plans
2	528204	Grading Plan & Profile
3	528205	Typical Road Sections
4	528206	Pier & Bulkhead - Plans & Details
5	528207	Pontoon Bridge - Plan & Details
6	528208	Float & Walkway Plans & Details
7	528209	Shore House Plans & Details
8	528210	Barge House Plans & Sections
9	528211	Barge House Elevations & Details
10	528212	Barge House Sections & Details
11	528213	Barge House - Mechanical
12	528214	Barge House - Electrical
13	528215	Shore House - Mechanical
14	528216	Shore House - Electrical

Figure 1. Location Map

11.

TRIADELPHIA LAKE

$d \approx 50'$

BARGE

BARGE RAIL CRANE

walkway

N

appx. shoreline

RECEIVING FLOAT

50 ft
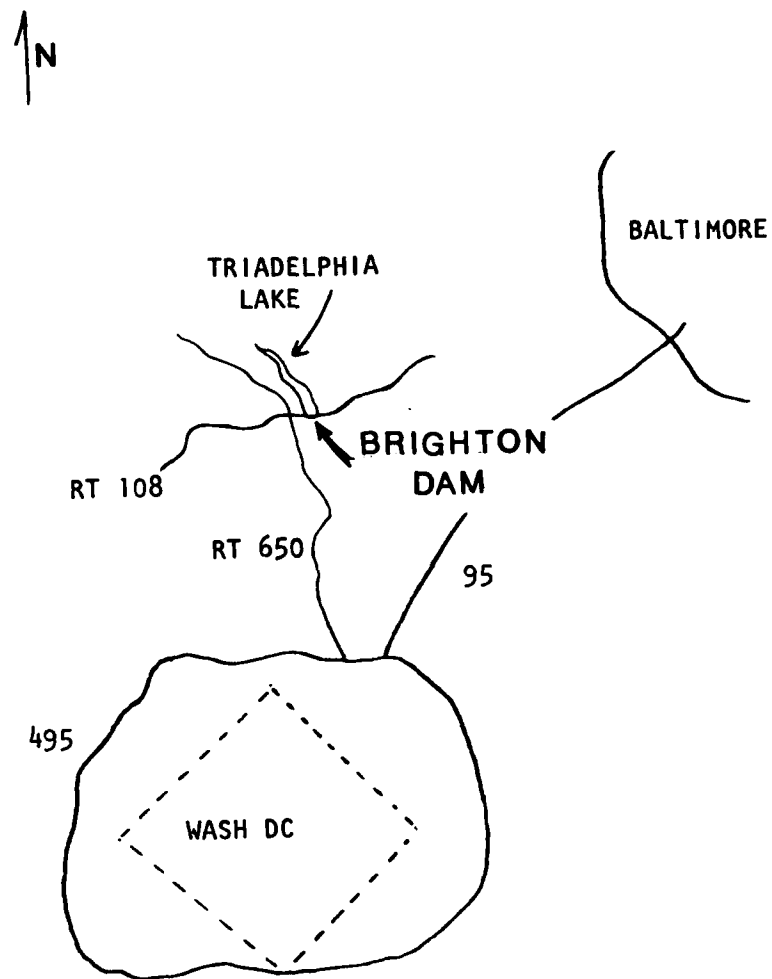
SHORE RAIL CRANE
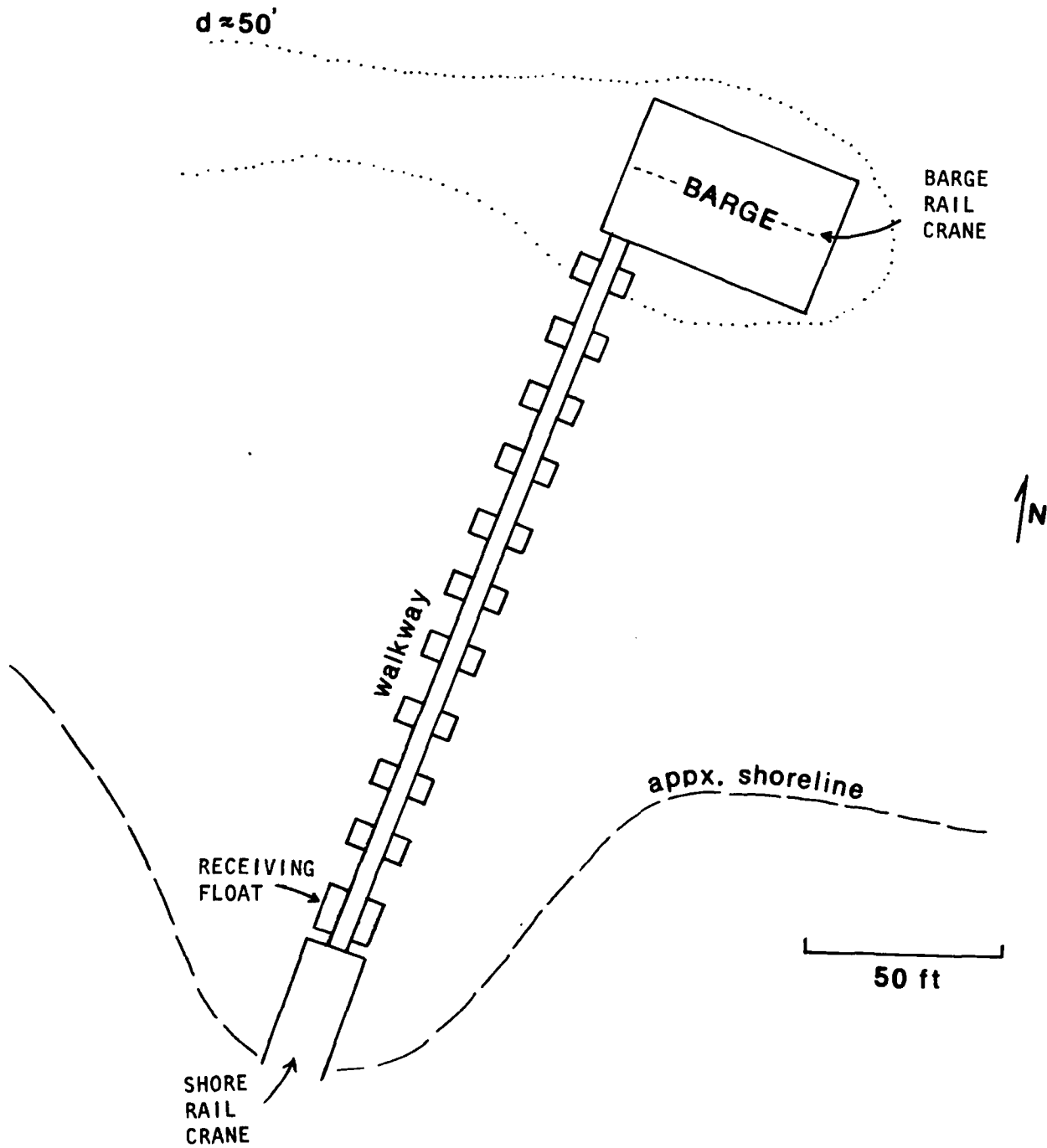
Figure 2. Plan of the Facility

Figure 3. Barge Freeboard Measurements 1978 thru 1984
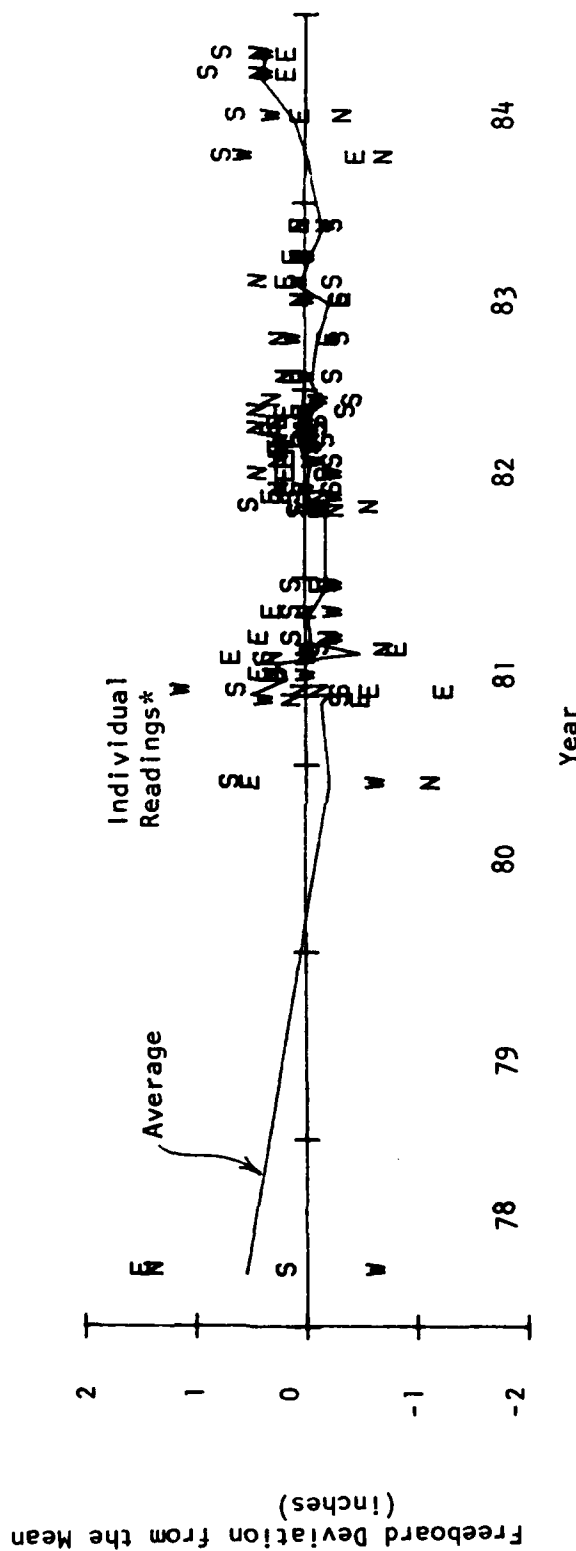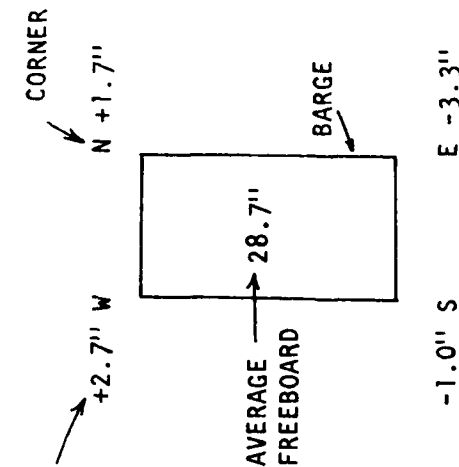
*Mean value at each corner of the barge removed to indicate trends

MEAN DEVIATION OF FREEBOARD AT EACH CORNER FROM AVERAGE

CORNER
N +1.7"

+2.7" W

AVERAGE FREEBOARD → 28.7"

E -3.3"

-1.0" S

BARGE

13.

A-1	A-2	A-3	A-4	A-5
B-1	B-2	B-3	B-4	B-5
C-1	C-2	C-3	C-4	C-5
D-1	D-2		D-4	D-5
E-1	E-2		E-4	E-5
F-1	F-2	TEST WELL	F-4	F-5
G-1	G-2		G-4	G-5
H-1	H-2		H-4	H-5
J-1	J-2		J-4	J-5
K-1	K-2	K-3	K-4	K-5
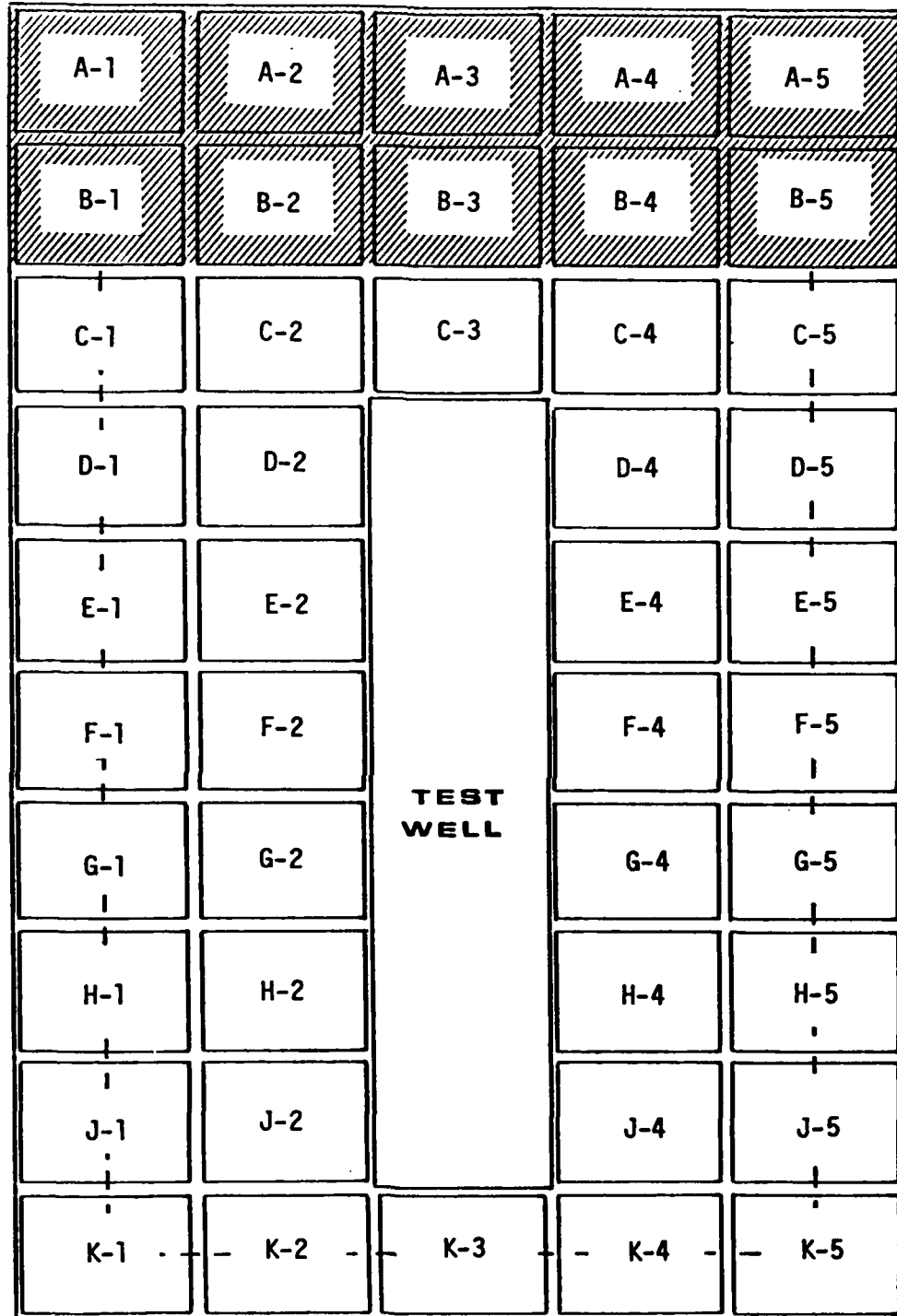
Figure 4. Pontoon Designation

(after Ref (1))
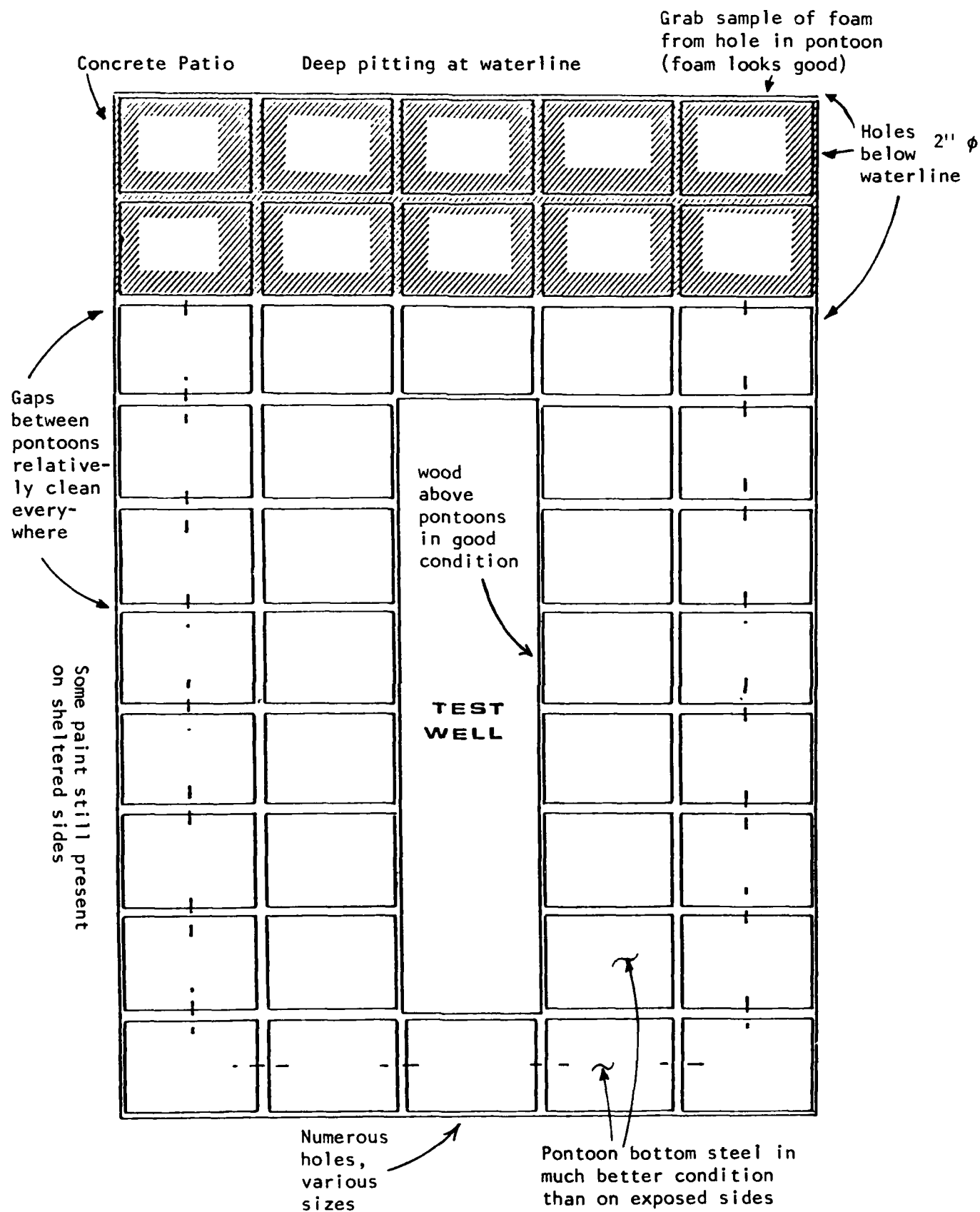
Figure 5. Underwater Inspection Notes

15.

Concrete Patio
90

30	N	30	50	N
N	N	40	10	60
30	N	40	75	0
N	N		50	N	10
N	25		10	N	70
N	N		10	N	60
30	25	TEST WELL	50	N
N	N		25	N	40
10	15		10	5	60
30	30	30	30	5	10

Pontoon Bottom

Pontoon Side

N = not measured
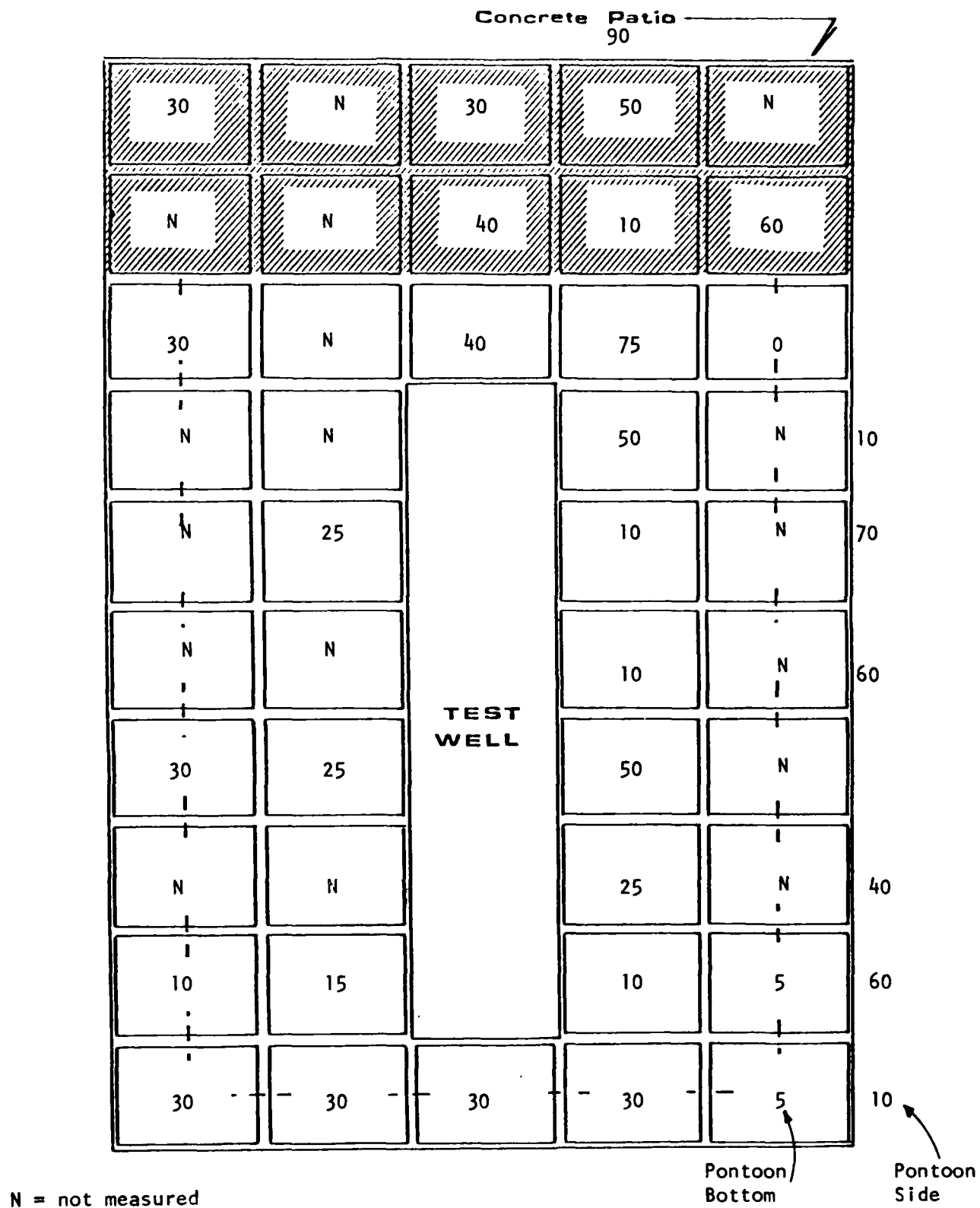
Figure 6.   Percent of Cleaned Area
That has Pitting

16.

APPENDIX A. RESERVE BUOYANCY CALCULATIONS

CHESAPEAKE	DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command	NDW	Station: Acoustic Facility
DISCIPLINE		E S R: NSWC Contract: G. Reid & W. Larson
Calcs made by: W. Seelig date: 11/6/84		Calculations for: Buoyancy
Calcs ck'd by: J. Hansen date: 4/5/35		

Barge "P" pontoons (see NAVFAC P-401, "Pontoon System Manual")

> 5' high
> 5' long
> 7' wide

What is buoyancy per inch of freeboard ?

Soln: Assume watertight as a first approximation.

$$\text{Buoyancy/inch freeboard} = \text{volume of displaced water} \times \text{Unit wt water}$$

$$= 44 \times 5' \times 7' \times \frac{1''}{12''/ft} \times 62.4 \text{ lbs/ft}^3$$

$$= \underline{\underline{8000 \text{ lbs/inch freeboard}}}$$

What is reserve buoyancy of barge ?

Y&D Drawing 528212 (4 June 1952)   Min freeboard = 18."

Average Freeboard (1978 thru 1984)   = 28.7"

Reserve Freeboard = 28.7" - 18" =   10.7"

Reserve buoyancy = 10.7" × 8000 lbs/in = $\underline{\underline{85,600 \text{ lbs}}}$

Assume 3 pontoons are completely flooded   (or less depending on amount of leakage into pontoons)

$\therefore$ Buoyancy = $\frac{44-3}{44}$ × 85,6000 = $\underline{80,000 \text{ lbs}}$

GPO 888-653

CHESAPEAKE DIVISION
Naval Facilities Engineering Command NDW
DISCIPLINE
Calcs made by: _W. Seelig_ date: _11/6/84_
Calcs ck'd by: _J. Hansen_ date: _4/5/85_

PROJECT: _Brighton Dam_
Station: _Acoustic Facility_
E S R: _NSWC_ Contract: _G. Reid & W. Larson_
Calculations for: _Buoyancy_

<u>What is the effect of water temperature on freeboard ?</u>

Fresh Water Density (from Ref (6))

Water Temp (°F)	Density Slugs/ft³	Unit Wt (lbs/ft³)
32	1.9399	62.417
60	1.9383	62.366
80	1.9336	62.215

For a given condition barge freeboard is directly proportional to water density. Water gets denser as it gets colder (see table above), so the barge should rise as water get colder.

Water Density change (80°F to 32°F) $= \dfrac{62.215 - 62.417}{62.366} \times 100\%$

$$= -0.324\%$$

Barge Freeboard Change (80°F to 32°F)

$= $ Average Freeboard $\times \%$ change in Water Density $/100\%$

$= 28.7'' \times (-0.324\%/100)$

$= \underline{-0.09 \text{ inches}}$

GPO 888-883

APPENDIX B.   SELECTED PHOTOS

Photo 1. Pontoon J-5 (SIDE) (Note 2" diameter hole in
          upper left of photo)

Photo 2. Pontoon B-3 (BOTTOM) (Condition good with most paint present

Photo 3.   Pontoon B-4   (Note localized pitting in metal
           to the left of the ruler)
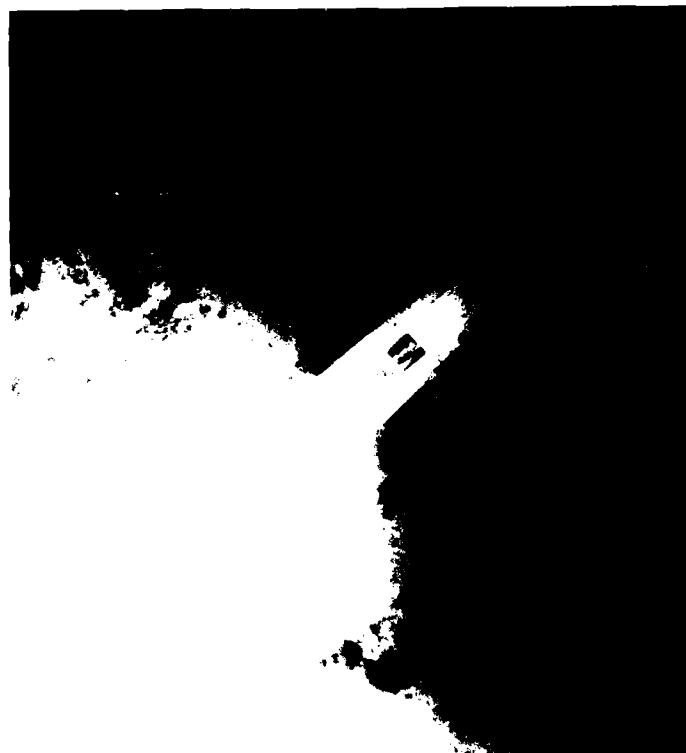
Photo 4.   Pontoon J-2   (Most of the metal in good
            condition with paint; localized pitting)

Appendix C. Analysis of the Receiving
                Float at Low Lake Levels

CHESAPEAKE DIVISION	PROJECT: NSWC ACOUSTIC FACILITY
Naval Facilities Engineering Command NDW	BRIGHTON DAM
DISCIPLINE	Station:
Calcs made by: W. SEELIG date: 3/25/85	E S R: _____ Contract: _____
Calcs ck'd by: J. Hammer date: 4/5/85	Calculations for: Receiving Pontoon Replacement

Background

Men and equipment are presently transfered from shore to the Brighton Dam Acoustic Facility via a floating bridge. The first segment of this bridge is a receiving float (see Sketch 1, next page). As long as the lake level is above approximately 354.8', then the receiving platform floats and works fine.

Problem   (Sketches 1 & 2)

When the lake level is less than 357.8', then the pontoons rest on the lake bed and the receiving float slopes (see Sketch 2). The lake level is lowered for periodic maintance of the dam conducted every four or five years (phonecall to Michael Greer, WSSC, 3/25/85 phone 774-9124) or when emergency repairs need to be made. Repairs are most often made during the winter months of January and February. For example, 21-23 Jan 85 the lake level was drawn down to 348.4' for dam repairs. The lake level is most often low during the winter. Ice on the sloping receiving platform produces hazardous working conditions.

Solution   (Sketch 3)

Redesign of the receiving float could save between 2.0' and 2.7' of pontoon draft (depending on loading) and thereby reduce the range of conditions when the pontoon hits the lake bed. The attached analysis outlines a proposed design and compares performance with the present float. A new receiving float is estimated to cost $20 K. Replacing the present float would result in minimum down time at the facility.

Alternatives (NOT RECOMMENDED)

Dredging - Would produce pollution, result in down time and could reduce the strength of the pier piles.

Extend Pier - Expensive, would result in significant down time and would require dismantling of the rail crane on the pier.
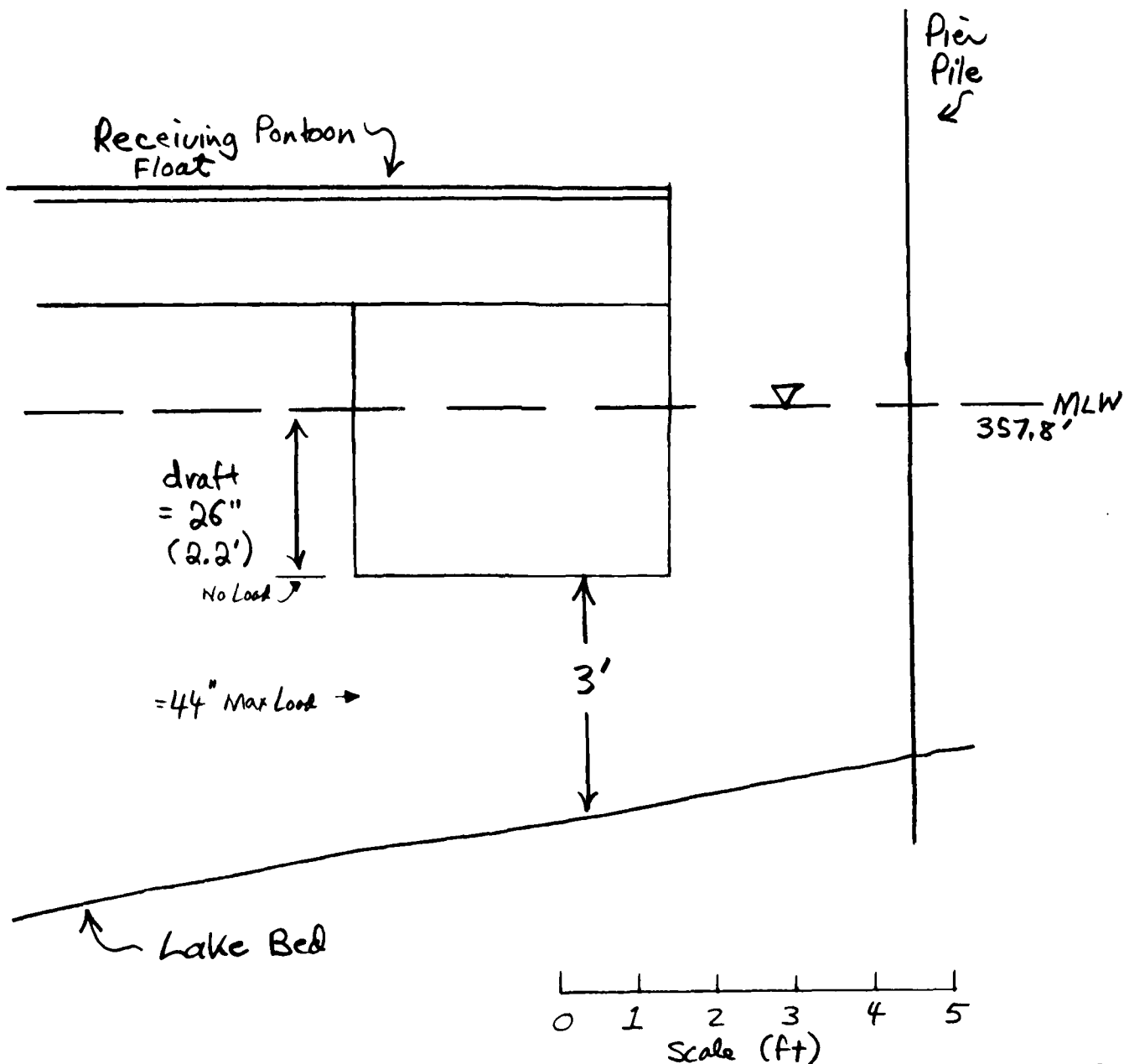
CHESAPEAKE DIVISION	PROJECT: _____
Naval Facilities Engineering Command NDW	Station: _____
DISCIPLINE	E S R: _____ Contract: _____
Calcs made by: _WM Seelig_ date:3/25/85	Calculations for: _____
Calcs ck'd by: _J. Hansen_ date: 4/5/85	_____

Present Float

Pier
Pile

Receiving Pontoon
Float

$\triangledown$

MLW
357.8'

draft
= 26"
(2.2')

No Load

= 44" Max Load →

3'

Lake Bed

0   1   2   3   4   5
Scale (ft)

GPO 885-883

Sketch 1.

CHESAPEAKE DIVISION	PROJECT: _____
Naval Facilities Engineering Command NDW	Station: _____
DISCIPLINE	E S R: _____ Contract: _____
Calcs made by: _W. N. Seelig___ date: 3/25/85	Calculations for: _____
Calcs ck'd by: _J. Hansen___ date: 4/5/85	_____

Present Float

Sloping deck
slippery with ice

Pier
Pile

-- MLW
357.8'

▽

Lake Bed

GPO 868-893

Sketch 2.

CHESAPEAKE DIVISION	PROJECT: _____
Naval Facilities Engineering Command NDW	Station: _Brighton Dam_
DISCIPLINE	E S R: _____ Contract: _____
Calcs made by: _W. Seelig_ date: 3/25/85	Calculations for: _Flood Draft Analysis_
Calcs ck'd by: _J. Hansen_ date: 4/5/85	

Present System $16' \times 21'$

4 pontoon $5' \times 7' \times 5'$

Volume disp/inch $= 4 \times 5' \times 7' \times \frac{1}{12}' = 11.667 \text{ ft}^3$

Buoyancy $= \text{Vol disp} \times 62.4 = 728 \text{ lbs/inch disp}$

Light Load   Draft (in/ft)

observed 26" (2.2')

Equip + Men

2000 lbs equip
300 lbs cart
600 lbs (4 men)
—————
2900 lbs $/728 \text{ lbs/in} = 3.98" \Rightarrow 29.98" (2.5')$
                          $+ 26"$

Snow + Ice

20 lbs/ft² snow $\Big\}$ NAVFAC
10 lbs/ft² Ice $\Big\}$ DM 2.2 "Loads"

30 lbs/ft² $\times 16' \times 21' = \dfrac{10,080 \text{ lbs}}{728 \text{ lbs/in}} = 13.85" \Rightarrow 43.8" (3.65')$

GPO 885-863

CHESAPEAKE   DIVISION
Naval Facilities Engineering Command   **NDW**
DISCIPLINE

Calcs made by: _W. N. Seely_   date: _3/25/85_
Calcs ck'd by: _J. Hansen_   date: _4/5/85_
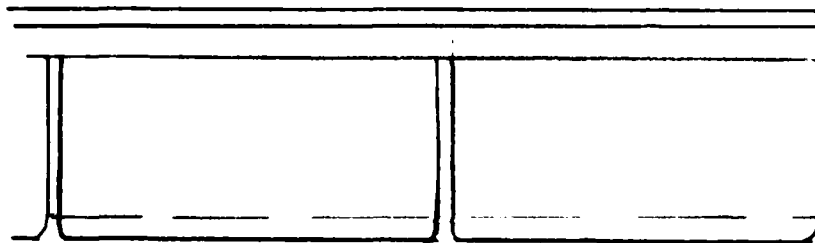
PROJECT: _____

Station: _____

E S R: _____ Contract: _____

Calculations for: _____

Recommended Float

Pier Pile

∇

← 2.5" No Load

← 11.2" Max Load

Sketch 3.

CHESAPEAKE	DIVISION	PROJECT: _____
Naval Facilities Engineering Command	NDW	Station: _Brighton Dam_
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: _W. Seelig_ date: 3/25/85		Calculations for: _Float Analysis_
Calcs ck'd by: _J. Hansen_ date: 4/5/85		

Proposed System   40 − 2'×4'×2' pontoons ("Polyfloat" or Equal)

Weight per float

Dead Load ("Light")   Draft (in/ft)

Wood $1.5'' \times 2' \times 4' + 12' \times 2'' \times 4''$
$= 1.44 \, ft^3 \times 40 \, lbs/ft^3 = 57. \, lbs$

Hardware $\underline{4 \, lbs}$

TOTAL   61 lbs   2.5" (0.2')

(see manufact's curve)

Equip & Men

$2900 \, lbs / 40 = 72.5 \, lbs + 61 \, lbs$ 5.0" (0.4')
$= 133.5 \, lbs \, per \, float$

Snow + Ice

$30 \, lbs/ft^2 \times 2' \times 4' = 240 \, lbs$ 11.2" (0.93')
$+ \underline{133.5 \, lbs}$
TOTAL   373.5 lbs

GPO 885-853

poly-float

DOCK BUILDING COMPONENT

Constructed of high density polyethylene casings filled with expanded polystyrene—lightweight yet heavy duty—won't warp or crack. Poly-Float versatility, durability and efficiency of installation mean top value for every dollar invested.

Poly-Floats are scientifically designed to provide the maximum in safety and environmental protection.

- No damaging sharp edges
- Will not conduct electricity
- No metal parts to rust and contaminate
- Won't break or pollute waterways like foam blocks
- Doesn't sink, even when severely damaged.
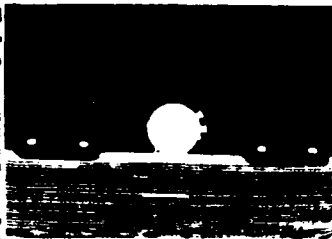
Mounting pads are furnished to facilitate end attachment of each Poly-Float to your dock. No extra straps or cables are required to secure floats permanently to structure.

TESTED & CERTIFIED
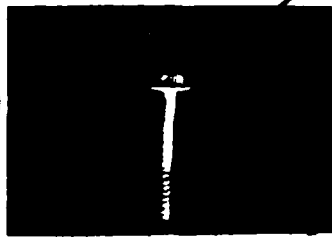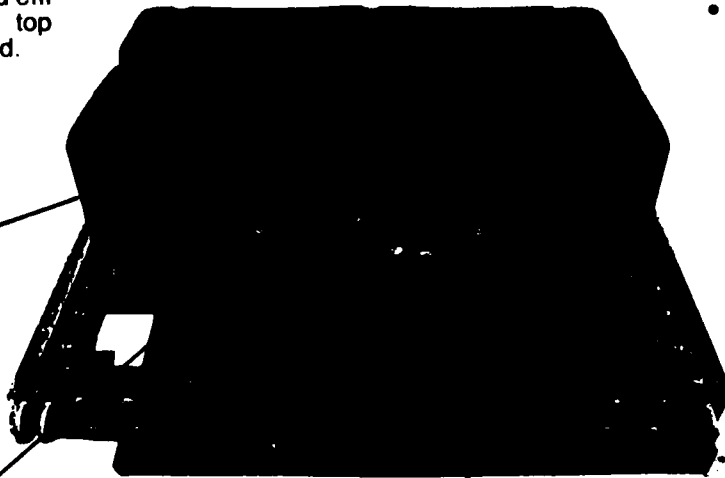
Recesses are incorporated along sides of each float offering additional or optional mounting areas should your specific design require custom fitting. Ample wrench clearance for convenient assembly.
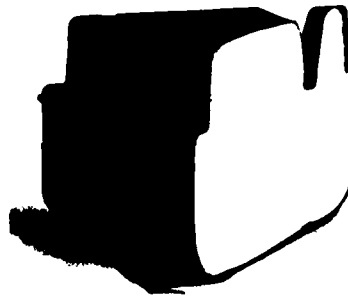
An inside look at rugged Poly-Float construction with total fill foamed-in-place closed-cell polystyrene. The rugged polyethylene casing is impervious to gasoline and oils, supplying permanent protection for the inner foam.
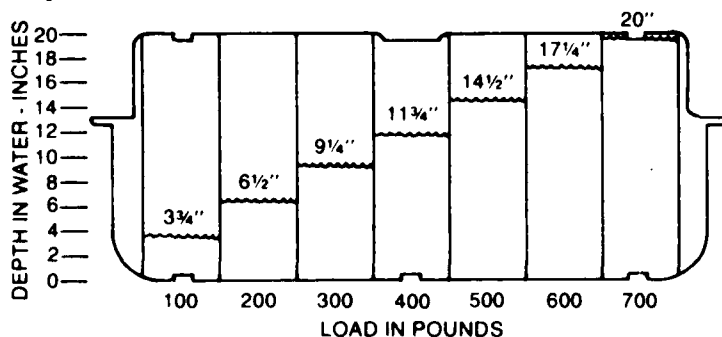
Specifications

Chart above shows the depth to which a Poly-Float will be submerged at specific loads. Calculate the "dead weight" plus the anticipated "live weight" of your system, then determine the freeboard required and find the load per float allowed at that depth to ascertain the number of floats needed. Mounting flanges are located at 13¼" submersion level. This equates to approximately 450 lbs. of load bearing capacity per float when submerged at flange level.
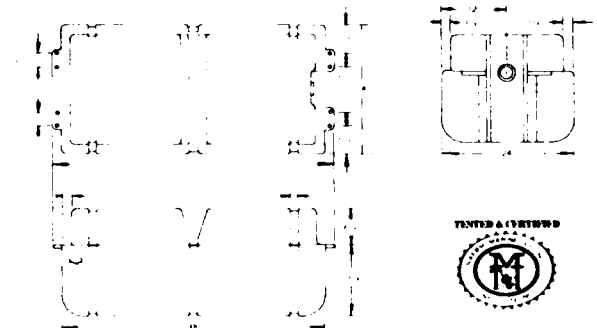
Poly-Floats have been tested and certified by the Marine Testing Institute, Inc. Dimensions shown here will assist you in designing your system. Poly-Floats assemble readily into 2' x 4' or 2' x 2' supporting structures. Your local distributor will be glad to help you determine the number of floats required and the best layout for even support.

ZARN, INC.
P.O. BOX 1350
REIDSVILLE, N.C. 27320
PHONE 919-349-3324
®Copyright 1980 ZARN, INC

CHESAPEAKE   **DIVISION**

Naval Facilities Engineering Command   **NDW**

DISCIPLINE

Calcs made by: _____ date: _____

Calcs ck'd by: _____ date: _____

PROJECT: _____

Station: _____

E S R: _____ **Contract:** _____

Calculations for: _____

_____

"Polyfloat"
polystyrene

MAX Load

Dead Load
+ Men & Equip

Dead Load

← float w/o any other load

Draft (inches)

TOTAL LOAD PER FLOAT
(lbs)
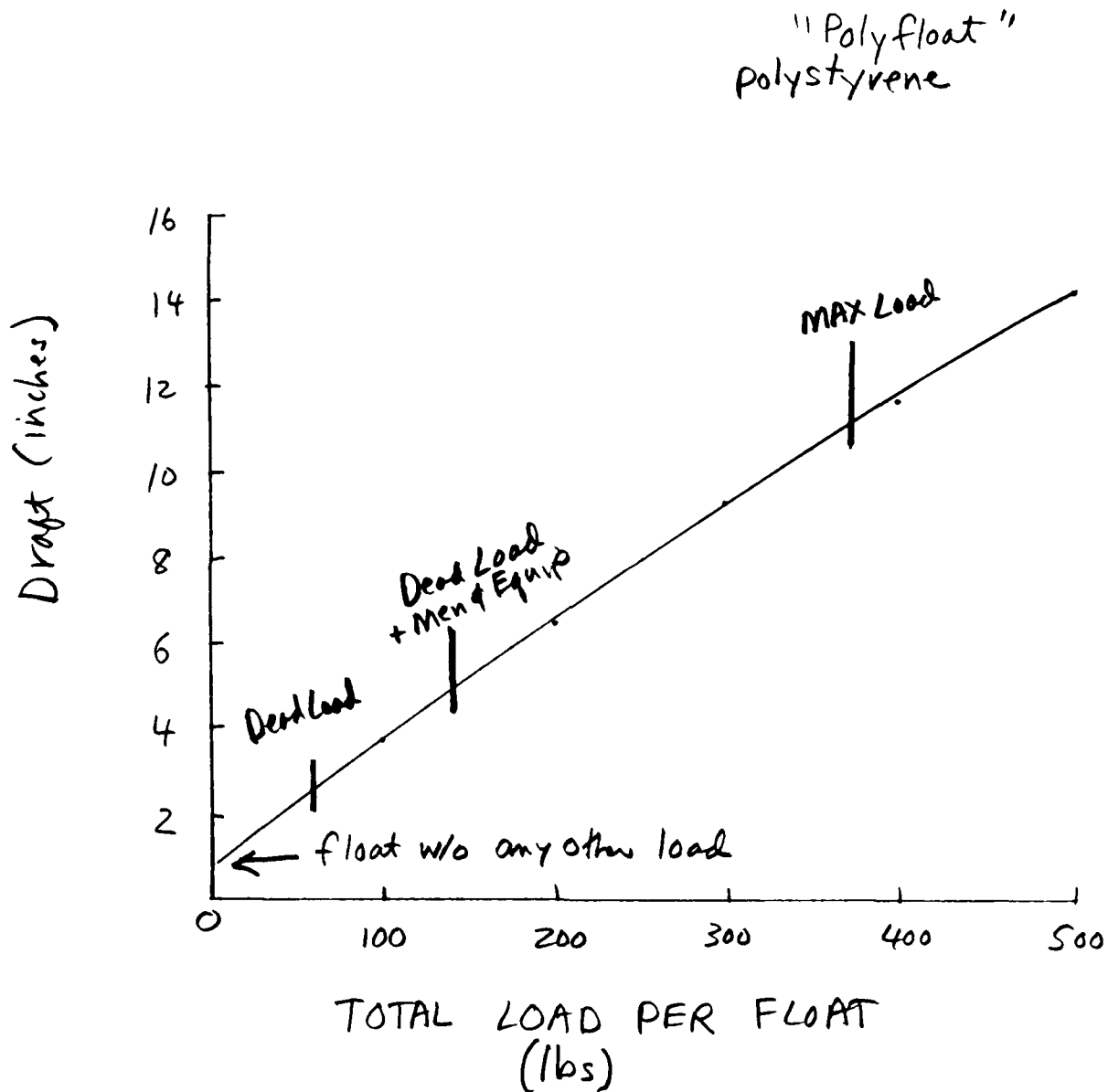
from manufactured specs.

GPO 885-683

Receiving Float Draft

Condition	Present	Proposed	Savings in Pontoon Draft
Dead Load	26"	2.5"	23.5" (2.0')
Dead Load +Men & Equip.	30"	5.0"	25" (2.1')
Dead Load +Men & Equip +Snow & Ice	43.8"	11.2"	32.6" (2.7')

CHESAPEAKE   DIVISION

Naval Facilities Engineering Command   **NDW**

DISCIPLINE

Calcs made by: _SCV_   date: _27 MAR 85_

Calcs ck'd by: _WM Seelig_   date: _27 Mar 85_

PROJECT: _NSWC Acoustic Facility_

Station: _Brighton Dam_

E S R: _____ Contract: _____

Calculations for: _Receiving Float Replacement_

LABOR

FIELD: $420/day × 3 days × 4 men. $ 5040

DESIGN: $163/day × 2 days × 1 man   326

DRAWINGS: 96/day × 2 days × 1 man   191.

     Direct Labor $ 5563

     overhead @ 125% of D.L.   6954

     profit @ 10% of DL + OH   1252

     13769.

Direct costs

① materials.

     Pontoons   3600

     bolts   480

     hardware   640

     wood.   752

     $ 5472   19241

② Shipping of mat'ls $ 600   TOTAL   19,841

Appendix D. Analysis of the Monorail Cranes

on the Barge and Onshore

CHESAPEAKE	DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command	NDW	Station: _____
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 3/26/85		Calculations for: Pontoon Barge Monorail
Calcs ck'd by: W. Seelig date: 4/1/85		

<u>Monorail</u>

  8" WF 17# $F_y = 36$ ksi (assumed)

  Design Manual DM 38.1   <u>Weight Handling Equipment</u>, June 1982

I. Design Factors - (Safety Factor)

  A. Monorail Crane - 5   Based upon Ultimate Strength

II. Design Loadings

  A. Dead Load

  B. Vertical Live Load - (in addition to design lift capacity)

    1. hook + sling loads

  C. Horizontal Load

    1. Lateral and Longitidunal loading - 5% of lift load

  D. Impact Load

    1. Trolley, - 50% static increase

III. Load Combinations
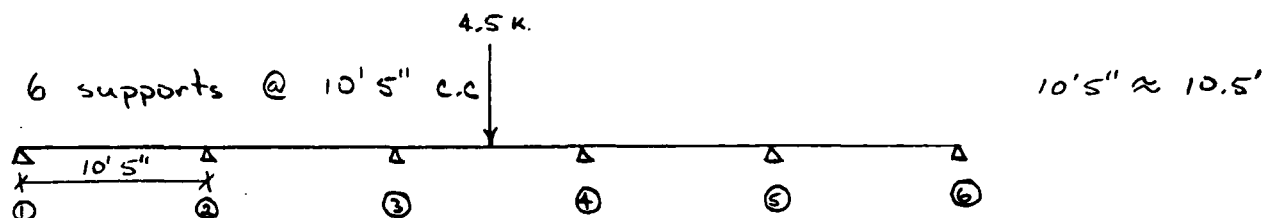
  A. Dead, live, impact, horizontal

CHESAPEAKE	DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command	NDW	Station:
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 3/26/85		Calculations for: Pontoon Barge Monorail
Calcs ck'd by: W. Seelig date: 4/1/85		

Pontoon Barge Monorail: 8" WF 17#   Assume $F_y = 36$ ksi

Total Static Load = LL + 50% LL + DL
                    (Impact)

Total Static Load = 3000-lbs + 1500-lbs = 4500-lbs (4.5 k.)

6 supports @ 10'5" c.c

4.5 k.

10'5" ≈ 10.5'

Fixed-End Moments:

$$FEM_{②④} = -\frac{PL}{8} = \frac{-(4.5k.)(10.5 ft.)}{8} = -5.91 \text{ K-ft.}$$

$$FEM_{④③} = \frac{PL}{8} = 5.91 \text{ K-ft.}$$

Distribution Factors:

$$DF_{②④} = \frac{K_i}{\Sigma K} = \frac{I/10'}{2(I/10')} = \frac{1}{2} = 0.5$$

$$DF_{④③} = 0.5$$

GPO 885-683

Moment Distribution:

1		.5	.5		.5	.5		.5	.5		.5	.5		1	

					-5.91	5.91						FEM
				2.955	2.955	-2.955	-2.955					DIST 1
		1.478	0	-1.478	1.478	0	-1.478					CO 1
	-0.739	-0.739	0.739	0.739	-0.739	-0.739	0.739	0.739				DIST 2
-0.369	0	0.369	-0.369	-0.369	0.369	0.369	-0.369	0	0.369			CO 2
0.369	-0.185	-0.185	0.369	0.369	-0.369	-0.369	0.185	0.185	-0.369			DIST 3
0	-0.92	0.92	3.69	-3.69	3.69	-3.69	-0.92	0.92	0			Final Moments

Loaded Interior Span

4.5 K.

$-3.69\,ft\cdot k$ (3) ⟶ (4) $3.69\ ft\cdot k$
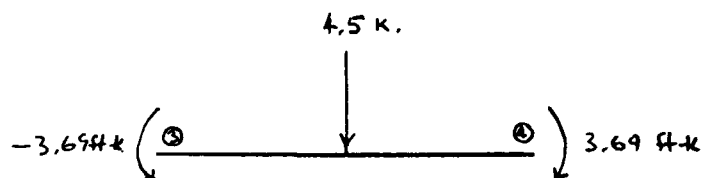
$V_3 = V_4 = 2.25$ K. ↑

CHESAPEAKE   **DIVISION**
Naval Facilities Engineering Command   **NDW**
DISCIPLINE

Calcs made by: J. Hansen   date: 3/27/85
Calcs ck'd by: W. Seeling   date: 4/1/85

PROJECT: Brighton Dam
Station:
E S R: Contract:
Calculations for: Pontoon Barge Monorail

$V(k.)$

2.25^k.

5.25'   5.25'   0

−2.25 k

8.12 k-ft.

$M(ft\cdot k)$
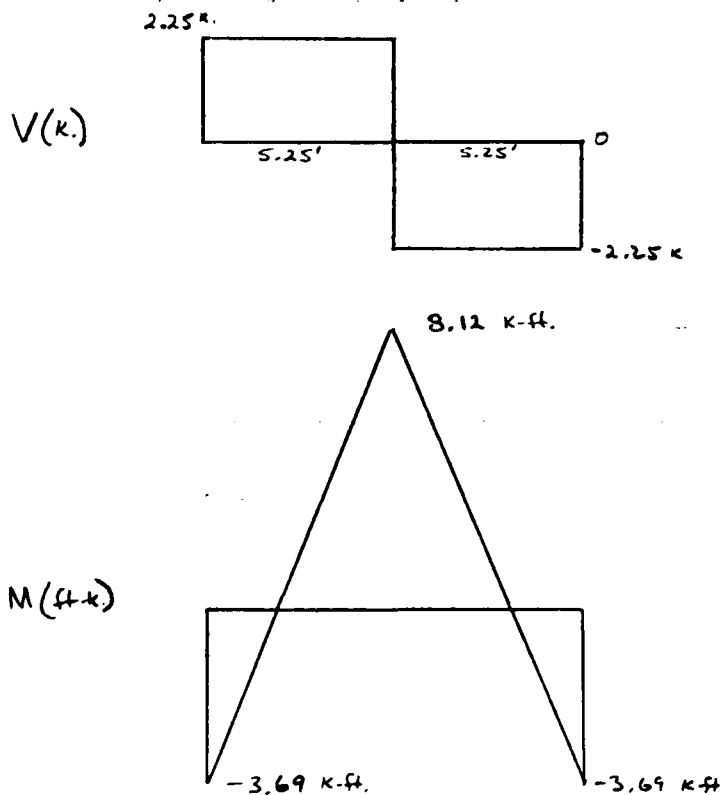
−3.69 k-ft.   −3.69 k-ft

$$Max.\ Mom. = (-3.69\ k\text{-}ft) + (2.25k)$$
$$\times\ (5.25\ ft)$$
$$M_M = 8.12\ k\text{-}ft$$

GPO 888-883

CHESAPEAKE DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command NDW	Station: _____
DISCIPLINE	E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 3/27/85	Calculations for: Pontoon Barge Monorail
Calcs ck'd by: W. Seelig date: 4/1/85	

Bending Stress:

Allowable bending stress, $F_b = 0.66 \, F_y$

$$F_b = 0.66 \, (36 \text{ ksi}) = 23.8 \text{ ksi}$$

Section modulus required, $S_x = \dfrac{M}{F_b}$
(AISC requirements)

$$S_x = \frac{8.12 \text{ K-ft} \, (12''/\!_1)}{23.8 \text{ ksi}} = 4.09 \text{ in.}^3$$

Section modulus provided, $\underline{S_x = 11.8 \text{ in.}^3}$

<u>DM 38.1</u>   SF = 5   Based upon ultimate strength.

$$F_b = \frac{0.66 \, F_u}{SF}$$

$$F_b = \frac{0.66 \, (58 \text{ ksi})}{5} = 7.66 \text{ ksi}$$

$$S_x \text{ (required)} = \frac{M}{F_b} = \frac{8.12 \text{ k-ft} \, (12''/\!_1)}{7.66 \text{ ksi}} = \underline{12.72 \text{ in.}^3}$$

GPO 885-853

CHESAPEAKE	DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command NDW		Station:
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 3/27/85		Calculations for: Pontoon Barge Monorail
Calcs ck'd by: M. Seelig date: 4/1/85		

Based upon <u>DM 38.1</u>,[*]

$$S_x \text{ (required)} < S_x \text{ (provided)}$$

$$\text{Overstress} = \frac{12.72 - 11.8}{12.72} = 0.07 \implies 7\% \text{ overstress}$$

[*] This application of DM 38.1 was confirmed by a telephone conversation on 27 March with Charles Sikora, Transportation Dept, CHES NAV FAC ENG COM.

Conclusion:

The 7% overstress is small, particularly when considering the safety factors; 1.5 for <u>AISC</u>, and 5 for <u>DM 38.1</u>. However, not included in this analysis are the lateral and longitudinal design loads. Although these loads are small, they will increase the overstress percentage.

Recommendation:

For a 3-k. rating, the next larger WF beam should be installed. However, the supporting structure for the monorail needs to be examined. The wooden supporting structure may prove to be even more of a limiting factor than the monorail.

GPO 888-883

CHESAPEAKE DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command NDW	Station:
DISCIPLINE	E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 3/27/85	Calculations for: Pier Monorail
Calcs ck'd by: M. Seelig date: 4/5/85	

Design Manual — DM 38.1 Weight Handling Equipment, June 1982

I. Design Factors — (Safety Factors)
   A. Monorail Crane — 5   Based upon ultimate strength

II. Design Loadings
   A. Dead Load
   B. Vertical Live Load
      1. hook and sling loads
      2. design lift capacity
   C. Horizontal Load
      1. lateral and longitudinal loading — 5% of lift load
   D. Impact Load
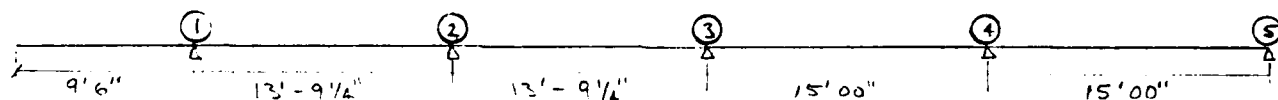   1. Trolley — 50% static increase

III. Load Combinations
   A. Dead, live, impact, horizontal

GPO 888-888

CHESAPEAKE   DIVISION
Naval Facilities Engineering Command   NDW
DISCIPLINE

Calcs made by: _J. Hansen_   date: _3/27/85_
Calcs ck'd by: _M. Seelig_   date: _4/5/85_

PROJECT: _Brighton Dam_
Station: _____
E S R: _____ Contract: _____
Calculations for: _Pier Monorail_

Pier Monorail — W 8 × 18

Total Static Load = DL + LL + Impact

$$= DL + LL + 50\% LL$$

$$= 18^{lb}/_{FT} + 3000\ lb. + 1500\ lb$$

$$= 18\ lb/_{FT} + 4.5\ k\ (point\ load)$$

Load Case Analysis — 3 conditions
1. point load at end of cantilever — Case 1
2. point load at center of 15' span
   a. end span — Case 2
   b. center span — Case 3

GPO 888-888

CHESAPEAKE	DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command	NDW	Station: _____ .
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 3/27/85		Calculations for: Pier Monorail
Calcs ck'd by: W. Seelig date: 4/5/85		_____

Case 1

Moment at end of cantilever:

$$M_1 = +\frac{wL^2}{2} + 4.5k(9.5ft.) = \frac{+0.018 \, k/ft \, (9.5ft)^2}{2} + 4.5k(9.5ft.)$$

$$M_1 = 43.562 \; k\text{-}ft.$$

Fixed - End Moments

$$FEM_{12} = \frac{-wL^2}{12} = \frac{-0.018 \, k/ft \, (13.771ft.)^2}{12} = -0.285 \; k\text{-}ft. = FEM_{23}$$

$$FEM_{21} = +0.285 \; k\text{-}ft = FEM_{32}$$

$$FEM_{34} = \frac{-wL^2}{12} = \frac{-0.018 \, k/ft. \, (15')^2}{12} = -0.338 \; k\text{-}ft = FEM_{45}$$

$$FEM_{43} = FEM_{54} = 0.338 \; k\text{-}ft.$$

Distribution Factors:

$$K_{12} = K_{23} = \frac{I_{12}}{L_{12}} = \frac{I}{13.771} \qquad\qquad K_{34} = K_{45} = \frac{I}{15.00}$$

GPO 888-883

CHESAPEAKE	DIVISION	PROJECT: _Brighton Dam_
Naval Facilities Engineering Command	NDW	Station: _____
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: _J. Hansen_ date: _3/27/85_		Calculations for: _Pier Monorail_
Calcs ck'd by: _W. Seehn_ date: _4/5/85_		

Case 1 (cont'd.)

$$DF_{12} = 1$$

$$DF_{21} = DF_{23} = \frac{I/13.771}{2(I/13.771)} = 0.5$$

$$DF_{32} = \frac{I/13.771}{I/13.771 + I/15} = \frac{7.1796}{13.771} = 0.5214$$

$$DF_{34} = 0.4786$$

$$DF_{43} = DF_{45} = 0.5$$

$$DF_5 = 1$$

GPO 888-888

CHESAPEAKE DIVISION

Naval Facilities Engineering Command   **NDW**

DISCIPLINE

| Calcs made by: J. Hansen | date: 4/3/85 |
| Calcs ck'd by: W. Seelig | date: 4/5/85 |

PROJECT: Brighton Dam

Station:

E S R: **Contract:**

Calculations for: Pier Monorail

Case 1 (cont.)

MOMENT DISTRIBUTION
4-SECTIONS

		1		2		3		4		5	
DISTRIBUTION FACTORS		1.0000	0.5000	0.5000	0.5214	0.4786	0.5000	0.5000	1.0000		DISTRIBUTION FACTORS
FEM	43.562	-0.29	0.29	-0.29	0.29	-0.34	0.34	-0.338	0.338		FEM
Dist.-1		-43.28	0.00	0.00	0.03	0.03	0.00	0.00	-0.34		Dist.-1
CO-1		0.00	-21.64	0.01	0.00	0.00	0.01	-0.17	0.00		CO-1
Dist.-2		0.00	10.81	10.81	0.00	0.00	0.08	0.08	0.00		Dist.-2
CO-2		5.41	0.00	0.00	5.41	0.04	0.00	0.00	0.04		CO-2
Dist.-3		-5.41	0.00	0.00	-2.84	-2.61	0.00	0.00	-0.04		Dist.-3
CO-3		0.00	-2.70	-1.42	0.00	0.00	-1.30	-0.02	0.00		CO-3
Dist.-4		0.00	2.06	2.06	0.00	0.00	0.66	0.66	0.00		Dist.-4
CO-4		1.03	0.00	0.00	1.03	0.33	0.00	0.00	0.33		CO-4
Dist.-5		-1.03	0.00	0.00	-0.71	-0.65	0.00	0.00	-0.33		Dist.-5
CO-5		0.00	-0.52	-0.35	0.00	0.00	-0.33	-0.17	0.00		CO-5
Dist.-6		0.00	0.44	0.44	0.00	0.00	0.25	0.25	0.00		Dist.-6
CO-6		0.22	0.00	0.00	0.22	0.12	0.00	0.00	0.12		CO-6
Dist.-7		-0.22	0.00	0.00	-0.18	-0.16	0.00	0.00	-0.12		Dist.-7
CO-7		0.00	-0.11	-0.09	0.00	0.00	-0.08	-0.06	0.00		CO-7
Dist.-8		0.00	0.10	0.10	0.00	0.00	0.07	0.07	0.00		Dist.-8
FINAL MOMENTS	43.562	-43.562	-11.273	11.273	3.241	-3.241	-0.303	0.303	0.000	0.000	FINAL MOMENTS

GPO 905-396

CHESAPEAKE DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command NDW	Station:
DISCIPLINE	E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 4/3/85	Calculations for: Pier Monorail
Calcs ck'd by: W. Seelig date: 4/5/85	

Case 1 (cont'd.)
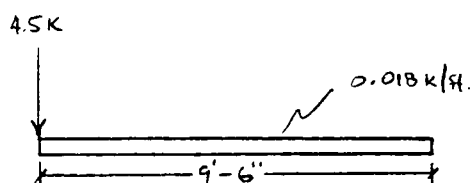
Max Moment = 43.562 K-ft

Bending Stress

Allowable bending stress, $F_b = 0.66 \, F_y$

$$F_b = 0.66 \,(36 \text{ ksi}) = 23.8 \text{ ksi}.$$

Section modulus required, $S_x = \dfrac{M}{F_b}$
(AISC requirements)

$$S_x = \frac{43.562 \text{ k-ft} \,(12''/_1)}{23.8 \text{ ksi}} = 21.96 \text{ in}^3$$

(DM 38.1 requirements SF = 5 based upon ultimate strength)

$$F_b = \frac{0.66 \, F_u}{SF} = \frac{0.66 \,(58 \text{ ksi})}{5} = 7.66 \text{ ksi}$$

$$S_x \,(\text{required}) = \frac{M}{F_b} = \frac{43.562 \text{ k-ft} \,(12''/_1)}{7.66 \text{ ksi}} = \underline{\underline{68.24 \text{ in}^3}}$$

Brighton Dam

CHESAPEAKE	DIVISION	PROJECT: ___Brighton Dam___
Naval Facilities Engineering Command	NDW	Station: _____
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 4/3/85		Calculations for: ___Pier Monorail___
Calcs ck'd by: W. Seelig date: 4/5/85		

Section Modulus provided, S_x

- On cantilevered end, a L4"×4"×½ is used to help stiffen the 8" WF. Unfortunately, I don't have a good drawing or description of how the angle is positioned. The following arrangement is a guess.

W 8×21
L 4×4×½
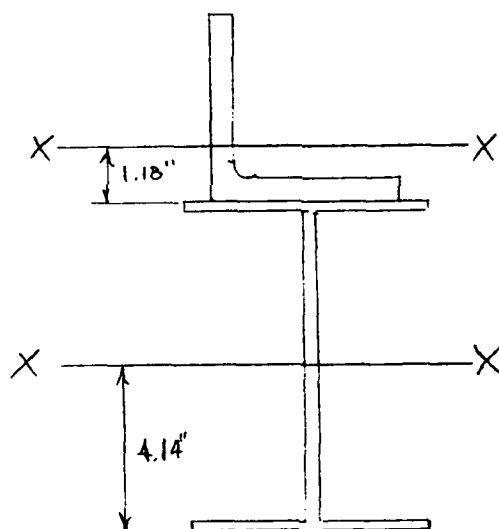
$I_L = 5.56 \text{ in.}^4$
$A_L = 3.75 \text{ in.}^2$
$S_L = 1.97 \text{ in.}^3$

$I_w = 75.3 \text{ in.}^4$
$A_w = 6.16 \text{ in.}^2$
$S_w = 18.2 \text{ in.}^3$

Need to determine "I" for the composite structure.

1st, find centroidal axis, $\bar{y}$

GPO 888-888

$$\bar{y} = \frac{A_L d_L + A_w d_w}{A_{L+w}}$$

$$\bar{y} = \frac{3.75\,in^2\left(1.18\,in + 8.28\,in\right) + 6.16\,in^2\left(4.14\,in\right)}{3.75\,in^2 + 6.16\,in^2} = 6.15\,in.$$

2nd, determine I_{w+L}

$$I_{w+L} = \left(I_L + Ad^2\right) + \left(I_w + Ad^2\right)$$

$$I_{w+L} = 5.56\,in^4 + 3.75\,in^2\left(9.46\,in. - 6.15\,in\right)^2 + 75.3\,in^4 + 6.16\,in^2\left(6.15\,in - 4.14\,in\right)^2$$

$$\underline{I_{w+L} = 146.83\,in^4}$$ (Moment of inertia about the X axis)

$$S_{w+L} = \frac{I}{c} = \frac{146.83\,in^4}{6.15\,in.} = 23.88\,in^3$$ (Section modulus provided)

GPO 888-888

CHESAPEAKE	DIVISION	PROJECT: Brighton Dam
Naval Facilities Engineering Command	NDW	Station:
DISCIPLINE		E S R: _____ Contract: _____
Calcs made by: J. Hansen date: 4/4/85		Calculations for: Pier Monorail
Calcs ck'd by: W. Seeling date: 4/5/85		

$$S_x \text{ (required)} \quad > \quad S_x \text{ (provided)}$$

$$68.24 \text{ in}^3 > 23.88 \text{ in}^3$$

Conclusion:

Based upon __DM 38.1__, the monorail member will be overstressed. A member with a larger section modulus or a shorter cantilever would solve the problem.

Check:

Assume the W8×21 is braced with __2__ L 4×4×½.

Determine new section modulus:

$$\bar{y} = \frac{2\left[3.75\text{in}^2 \left(1.18\text{in.} + 8.28\text{in}\right)\right] + 6.16 \text{ in}^2 \left(4.14 \text{ in}\right)}{2\left(3.75\text{in}^2\right) + 6.16\text{in}^2} = 7.06 \text{ in.}$$

CHESAPEAKE   **DIVISION**

Naval Facilities Engineering Command   **NDW**

DISCIPLINE

Calcs made by: _J. Hansen_   date: _4/4/85_

Calcs ck'd by: _W. Scelig_   date: _4/5/85_

PROJECT: _Brighton Dam_

Station: _____

E S R: _____ **Contract:** _____

Calculations for: _Pier Monorail_

_____

$$I_{w+2L} = 2\left(I_L + Ad^2\right) + \left(I_w + Ad^2\right)$$

$$= 2\left(5.56\ in.^4 + 3.75\ in.^2\left(9.16\ in - 7.06\ in\right)^2\right)$$
$$+ 75.3\ in.^4 + 6.16\ in.^2\left(7.06\ in. - 4.14\ in.\right)^2$$

$$I_{w+2L} = 182.14\ in.^4 \qquad \text{(Moment of inertia about the } x\text{-axis)}$$

$$S_{w+2L} = \frac{I}{c} = \frac{182.14\ in.^4}{7.06\ in.} = \underline{25.80\ in.^3}$$

$$S_x\ (required) > S_x\ (provided)$$

Conclusion:

A much larger beam would have to be used to safely support a 3000-lb rating. Load cases 2 and 3 were not examined since the bending moment from case 1 is greater than a bending moment from either case 2 or 3.

GPO 888-088

END

DTIC

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